SECTIONS 5.1–5.2

R1. Consider the transportation analogy in Section 5.1.1. If the passenger is analagous to a datagram, what is analogous to the link layer frame?

R2. If all the links in the Internet were to provide reliable delivery service, would the TCP reliable delivery service be redundant? Why or why not?

R3. What are some of the possible services that a link-layer protocol can offer to the network layer? Which of these link-layer services have corresponding services in IP? In TCP?

SECTION 5.3

R4. Suppose two nodes start to transmit at the same time a packet of length L over a broadcast channel of rate R. Denote the propagation delay between the two nodes as d_{prop}. Will there be a collision if $d_{prop} < L/R$? Why or why not?

R5. In Section 5.3, we listed four desirable characteristics of a broadcast channel. Which of these characteristics does slotted ALOHA have? Which of these characteristics does token passing have?

R6. In CSMA/CD, after the fifth collision, what is the probability that a node chooses $K = 4$? The result $K = 4$ corresponds to a delay of how many seconds on a 10 Mbps Ethernet?

1. The transportation mode, e.g., car, bus, train, car.

2. Although each link guarantees that an IP datagram sent over the link will be received at the other end of the link without errors, it is not guaranteed that IP datagrams will arrive at the ultimate destination in the proper order. With IP, datagrams in the same TCP connection can take different routes in the network, and therefore arrive out of order. TCP is still needed to provide the receiving end of the application the byte stream in the correct order. Also, IP can lose packets due to routing loops or equipment failures.

3. Framing: there is also framing in IP and TCP; link access; reliable delivery: there is also reliable delivery in TCP; flow control: there is also flow control in TCP; error detection: there is also error detection in IP and TCP; error correction; full duplex: TCP is also full duplex.

4. There will be a collision in the sense that while a node is transmitting it will start to receive a packet from the other node.

5. Slotted Aloha: 1, 2 and 4 (slotted ALOHA is only partially decentralized, since it requires the clocks in all nodes to be synchronized). Token ring: 1, 2, 3, 4.

6. After the 5^{th} collision, the adapter chooses from {0, 1, 2,…, 31}. The probability that it chooses 4 is 1/32. It waits 204.8 microseconds.

R7. Describe polling and token-passing protocols using the analogy of cocktail party interactions.

R8. Why would the token-ring protocol be inefficient if a LAN had a very large perimeter?

SECTION 5.4

R9. How big is the MAC address space? The IPv4 address space? The IPv6 address space?

R10. Suppose nodes A, B, and C each attach to the same broadcast LAN (through their adapters). If A sends thousands of IP datagrams to B with each encapsulating frame addressed to the MAC address of B, will C's adapter process these frames? If so, will C's adapter pass the IP datagrams in these frames to the network layer C? How would your answers change if A sends frames with the MAC broadcast address?

R11. Why is an ARP query sent within a broadcast frame? Why is an ARP response sent within a frame with a specific destination MAC address?

7. In polling, a discussion leader allows only one participant to talk at a time, with each participant getting a chance to talk in a round-robin fashion. For token ring, there isn't a discussion leader, but there is wine glass that the participants take turns holding. A participant is only allowed to talk if the participant is holding the wine glass.

8. When a node transmits a frame, the node has to wait for the frame to propagate around the entire ring before the node can release the token. Thus, if L/R is small as compared to t_{prop}, then the protocol will be inefficient.

9. 2^{48} MAC addresses; 2^{32} IPv4 addresses; 2^{128} IPv6 addresses.

10. C's adapter will process the frames, but the adapter will not pass the datagrams up the protocol stack. If the LAN broadcast address is used, then C's adapter will both process the frames and pass the datagrams up the protocol stack.

11. An ARP query is sent in a broadcast frame because the querying host does not which adapter address corresponds to the IP address in question. For the response, the sending node knows the adapter address to which the response should be sent, so

R12. For the network in Figure 5.19, the router has two ARP modules, each with its own ARP table. Is it possible that the same MAC address appears in both tables?

R13. Compare the frame structures for 10BASE-T, 100BASE-T, and Gigabit Ethernet. How do they differ?

R14. Consider Figure 5.15. How many subnetworks are there, in the addressing sense of Section 4.4?

R15. What is the maximum number of VLANs that can be configured on a switch supporting the 802.1Q protocol? Why?

R16. Suppose that N switches supporting K VLAN groups are to be connected via a trunking protocol. How many ports are needed to connect the switches? Justify your answer.

12. No it is not possible. Each LAN has its own distinct set of adapters attached to it, with each adapter having a unique LAN address.

13. The three Ethernet technologies have identical frame structures.

14. 2 (the internal subnet and the external internet)

15. In 802.1Q there is a 12- bit VLAN identifier. Thus 2^{12} = 4,096 VLANs can be supported.

16. We can string the N switches together. The first and last switch would use one port for trunking; the middle N-2 switches would use two ports. So the total number of ports is 2+ 2(N-2) = 2N-2 ports.